PB84-143577

EPA (Environmental Protection Agency) Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

(U.S.) Environmental Protection Agency
Ann Arbor, MI

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EPA Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

by

Stanley L. Syria

June 1983

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report announces the conclusions of the Environmental Protection Agency (EPA) evaluation of the "Gyroscopic Wheel Cover" under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act.

The evaluation of the Gyroscopic Wheel Cover device was conducted upon the application of Simmer Wheels, Incorported. The device is a mechanical assembly which replaces each of the standard wheel covers on a vehicle. The device is claimed to improve fuel economy, handling and braking characteristics, and the life of the brakes and tires.

EPA fully considered all of the information submitted by the applicant. The evaluation of the Gyroscopic Wheel Cover device was based on that information and EPA's engineering judgement. The applicant failed to submit adequate information and data which would substantiate his claims for the device. Additionally, if the device can correct an inbalance condition, EPA is doubtful it can cause significant benefits over tires and wheels that are balanced using conventional methods and wheel weights. Thus, EPA has no technical reason to support the claims made for the device or to continue the evaluation on its own.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Automobiles Fuel Consumption Tests Tires	Fuel Economy Gas Saving Device Vehicle Brakes	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
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EPA Form 2220-1 (9-73)

EPA Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

The Motor Vehicle Information and Cost Savings Act requires that EPA evaluate fuel economy retrofit devices and publish a summary of each evaluation in the Federal Register.

EPA evaluations are originated upon the application of any manufacturer of a retrofit device, upon the request of the Federal Trade Commission, or upon the motion of the EPA Administrator. These studies are designed to determine whether the retrofit device increases fuel economy and to determine whether the representations made with respect to the device are accurate. The results of such studies are set forth in a series of reports, of which this is one.

The evaluation of the Gyroscopic Wheel Cover device was conducted upon the application of Zimmer Wheels, Incorporated. The device is a mechanical assembly which replaces each of the standard wheel covers on a vehicle. The device is claimed to improve fuel economy, handling and braking characteristics, and the life of the brakes and tires.

1. Title:

Application for Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

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The information contained in sections two through five which follow, was supplied by the applicant.

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2. Identification Information:

a. Marketing Identification of the Product:

"Zimmer Wheels, Inc. has exclusive marketing rights in the United States for both the Executive and Sport Model GYROSCOPIC WHEEL COVER."

b. Inventor and Patent Protection:

(1) Inventor

"Kim Rush of 6 Emperor, Irvin, CA 92714 is the inventor of this invention."

(2) Patent

"Copy of patent is enclosed." [Attachment A of this evaluation]

c. Applicant:

(1) Name and address

"Zimmer Wheels, Inc. of 1330 Leyden #103, Denver, CO 80220 is applying for this evaluation."

(2) Principals

"President of Zimmer Wheels, Inc. is Suzanne Branch, Vice President is Linda Potter and Chairman of the Board is David Branch."

(3) "Dave Hudson of 6759 West 70th Street, Arvada, CO 80003 and Tom Johnson of 2013 Beech Court, Golden, CO 80401 are authorized to represent Zimmer Wheels, Inc. in communications with EPA in connection with this evaluation request only. Their phone numbers are (303) 425-1870 and 233-3053 respectively."

d. Manufacturer of the Product:

(1) Name and address

"Konzu Machinery and Industry C., Ltd. NO. 77-3, Nanshin Village Linkou, Taipei, Shien, Taiwan, ROK manufactures the product."

(2) Principals

"Principal owners are Mr. S. L. Wang, Mrs. Wang and Patsy Cheng."

3. Description of Product:

a. Purpose:

"The purpose of this invention is to provide an imbalance compensating vehicle wheel attachment to improve stability and performance."

b. Applicability:

(1) "This invention fits all rear wheel drive vehicles with 13, 14, and 15 inch standard wheels. It will not fit on wheels that have the axle extending out beyond the outer edge of the wheel rim."

(2) "Gyroscopic Wheel Covers improve vehicle performance in all driving conditions, i.e., icy, snowy, rough roads, wet, cornering and stopping."

c. Theory of Operation:

"The Gyroscopic Wheel Cover has a 12-gauge steel movable back plate, movable spokes, and is suspended within the wheel by steel spring grippers. The force created by the tire striking the ground creates a radius of gyration, six pounds of movable heavy-gauge steel which gives a perfect geometric center with a perfect center of gravity giving a perfectly balanced wheel. This eliminates tire bounce and greatly enhances stabilization.

"The 360 [degrees] of flexing gyroscopic mass forces the geometric center and center of gravity to become aligned thereby causing an automatic wheel balance that shifts and adjusts to compensate for any imbalance in road conditions or speed change. The Gyroscopic Wheel Covers react in millimicroseconds to maintain constant balance. This continuous response creates a perfect wheel balance and constant stabilization that results in the rear wheels exerting a steady push while the front wheels offer less resistance to rolling." [See Attachments B and C for additional information regarding the theory of operation.]

d. Construction and Operation:

"Detailed description - See Patent which is enclosed." [Attachment A].

e. Specific Claims for the Product:

"Up to 16% or better in gas mileage. Testing done by an approved Federal testing laboratory, National Testing Standards, Inc.[1] (DCAS No. 4-S-502). Several tests were done; a copy of one of the tests is enclosed [Attachment D], others have been requested and will be forwarded upon receipt." [See Attachment E for additional claims.]

f. Cost And Marketing Information:

"Suggested retail prices:

Executive model	$390 (set of four)
Sport Model	$350

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[1] National Testing Standards, Incorporated is neither a U.S. Government entity, nor is it currently recognized by EPA as being capable of performing fuel economy and exhaust emissions tests for purposes of Section 511 of the Motor Vehicle Information and Cost Savings Act.

Marketing is through a multi-level marketing system. The product is in production."

4. Product Installation, Operation, Safety and Maintenance:

   a. Installation - Instructions, Equipment, and Skills Required:

      "A copy of the installation instructions is enclosed." [Attachment F]

   b. Operation:

      "This invention does not require operating instructions."

   c. Effects on Vehicle Safety:

      "Not applicable"

   d. Maintenance:

      "Not applicable"

5. Effects on Emissions and Fuel Economy:

   a. Unregulated Emissions:

      "Not applicable"

   b. Regulated Emissions and Fuel Economy:

      "This invention does not affect emissions. Fuel economy increases as shown in the enclosed literature." [Although not specified, the enclosed literature referred to by the applicant is assumed to be Attachments D, E, and G. Attachment G is a collective testimonial.]

The following Sections are EPA's analysis and conclusions for the device.

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6. Analysis:

   EPA evaluated the application and found no problems with the information regarding device identification, purpose, construction, operation, cost, marketing, maintenance, and unregulated exhaust emissions.

   With respect to the information given in the balance of the application, EPA has noted the following concerns.

a. The applicant states the device is applicable to all rear wheel drive vehicles but does not mention whether it is applicable to front wheel drive vehicles. It appears to EPA that the device could be applicable to front wheel drive vehicles, although when the applicant was asked about this he did not respond (Attachment H). Additionally, although "Mag" type wheels were not addressed, EPA is doubtful that the device will adapt to these because of the wheel flange and bead design.

b. The theory of operation given by the applicant suggests the device is capable of compensating for imbalance in wheels and tires. However, since adequate data were not submitted which substantiated the theory of operation, and since a sample device was not provided, EPA does not know if the device functions as claimed.

c. Several benefits are claimed for the device although the applicant did not submit adequate substantiating data for any of the claims. If the device is indeed capable of compensating for imbalance, then EPA would expect insignificant, or no benefits when compared to a tire that is balanced in the conventional manner, i.e., with wheel weights. To achieve a gain in fuel economy of 16 percent, would require that initially the tires/wheels be terribly out of balance. EPA is doubtful that very many vehicles are being driven with tires in such a state of balance, or that they are driven very far. Additionally, considering the six pounds of extra weight added to each of the four wheels, the device may have an adverse effect on fuel economy due to the increased weight. The extra weight may also have an adverse effect on roadability and riding quality because the unsprung weight of the wheel/axle system is increased. For lack of adequate data to support the various claims made by the applicant, and also because it was not proven to EPA the device could compensate for an imbalance condition, the Agency has no technical reason for expecting the device to achieve any of the claims made for it.

d. The installation instructions state to remove certain components i.e., cap and basket, but fail to mention whether they are to be reinstalled. Additionally, although retaining clips are shown in the instructions and discussed in the patent, they are not mentioned in the installation instructions. The applicant was asked about this but he did not respond.

e. With respect to safety, the applicant states, "not applicable." However, in Attachments B, C and E it is stated the device provides for safer vehicle operation. EPA does not know if the applicant's statement of "not applicable" means the device has no effect on safety (contrary to that claimed in the attachments), or if it was an oversight by the applicant. If the device is indeed capable of improving tire and wheel balance, then the safety factor would also be improved through better tire contact with the road surface.

f. The applicant states the device does not affect exhaust emissions. However, Attachment C states that vehicle rolling resistance is reduced when using the device. If this were true, then emission levels as well as fuel economy levels are likely to change. The applicant did not submit any data showing the effect on emissions due to the device.

The applicant did submit data (Attachments D and G) to substantiate the fuel economy benefits claimed. Those data were not adequate because multiple vehicles were not subject to replicate testing under closely controlled test conditions. EPA requested additional test data following an EPA recommended test plan (Attachment H). However, the applicant did not submit any additional data. Eventually, the applicant notified EPA he would not be testing the device in the immediate future.

EPA did not test the device for this evaluation because the data submitted by the applicant did not substantiate the claims for better wheel balance or that better wheel balance would result in any fuel economy or handling benefits.

7. Conclusions:

EPA fully considered all of the information submitted by the applicant. The evaluation of the Gyroscopic Wheel Cover device was based on that information and EPA's engineering judgment. The applicant failed to submit adequate information and data which would substantiate his claims for the device. Additionally, if the device can correct an imbalance condition, EPA is doubtful it can cause significant benefits over tires and wheels that are balanced using conventional methods and wheel weights. Thus, EPA has no technical reason to support the claims made for the device or to continue the evaluation on its own.

FOR FURTHER INFORMATION CONTACT: Merrill W. Korth, Emission Control Technology Division, Office of Mobile Sources, Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, MI 48105, (313) 668-4299.

List of Attachments

Attachment A	Copy of the Patent Application (provided with 511 Application).
Attachment B	Copy of report titled, An Automatic Tire and Wheel Balancer, by George S. Schlemmer.
Attachment C	Copy of report titled, Has Rolling Resistance Been Decreased at Last, by George S. Schlemmer.
Attachemnt D	Copy of test report from National Testing Standards, Inc., November 5, 1979.
Attachment E	Copy of advertising brochure.
Attachment F	Copy of installation instructions.
Attachment G	Collective testimonial.
Attachment H	Copy of a letter from EPA to Energy Team for Conservation, February 24, 1983.

Patent Lawyers
610 Fidelity Federal Plaza
555 East Ocean Boulevard
Long Beach, California 90802

United States Patent [19]
Rush

[11] 4,268,090
[45] May 19, 1981

[54] IMBALANCE COMPENSATING VEHICLE WHEEL ATTACHMENT

[75] Inventor: Kim E. Rush, Irvine, Calif.

[21] Appl. No.: 157,547

[22] Filed: Jun. 9, 1980

[51] Int. Cl.³ B60B 7/04; B60B 13/00
[52] U.S. Cl. ..... 301/5 BA; 301/37 R; 74/573 R
[58] Field of Search ..... 301/37 R, 37 N, 37 CM, 301/37 S, 37 SS, 5 B, 5 BA, 37 B, 41 W; 74/573 R, 574; 295/6-7

[56] References Cited

U.S. PATENT DOCUMENTS

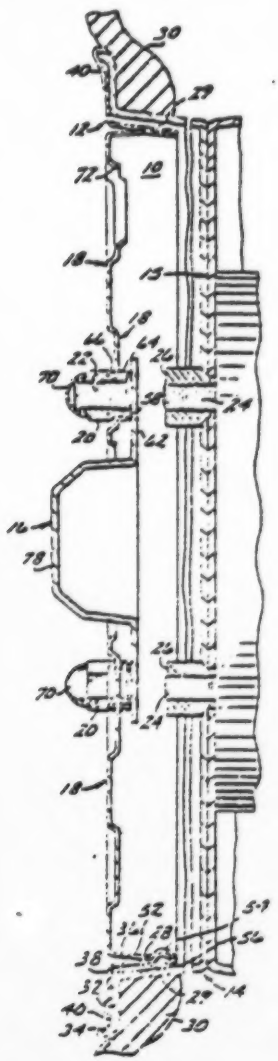
3,312,503 4/1967 Hutchins ..... 301/37 SS
4,178,041 12/1979 Rush ..... 301/37 R X

Primary Examiner—Charles A. Marmor
Attorney, Agent, or Firm—Fulwider, Patton, Rieber, Lee & Utecht

[57] ABSTRACT

An imbalance compensating vehicle wheel attachment having a rim structure for mounting to a vehicle wheel, and further having a plurality of spokes or sectors coupled to the rim structure and extending radially inwardly to a hub structure. A mounting arrangement is provided to couple the inward extremities of the sectors to the hub structure to enable radial slidable movement of the sectors relative to the hub structure whereby the masses of the hub structure and sectors are dynamically movable to establish a radius of gyration tending to compensate for any wheel imbalance.

11 Claims, 8 Drawing Figures



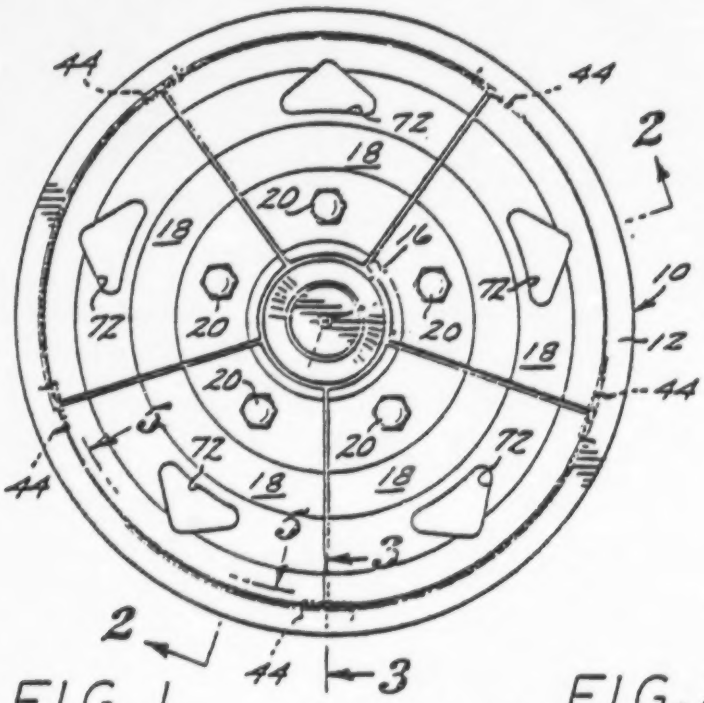


FIG. 1

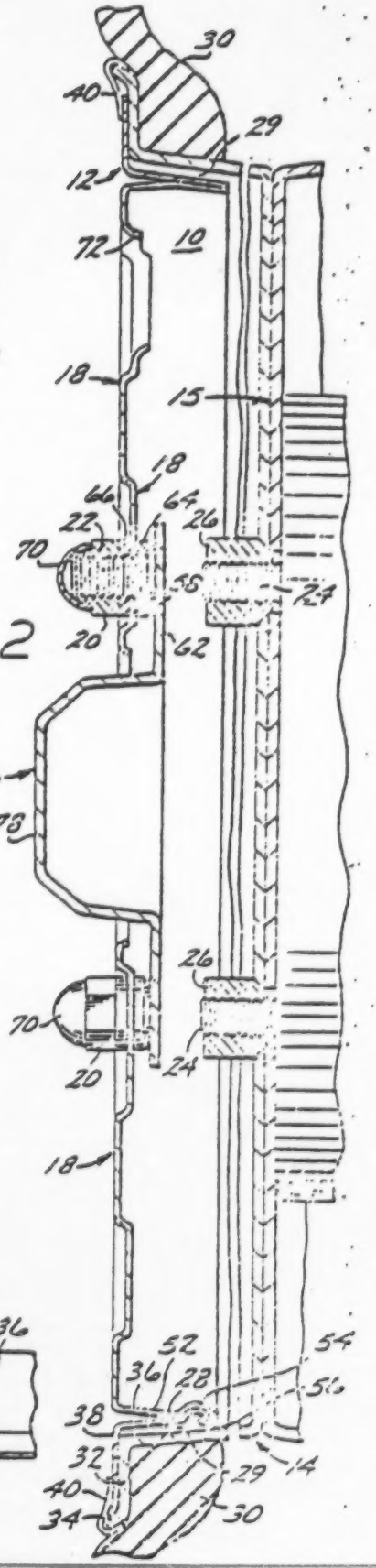


FIG. 2

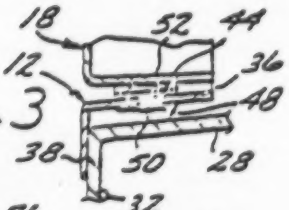


FIG. 3

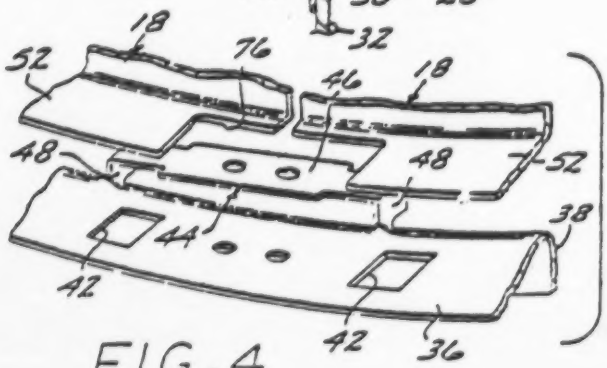
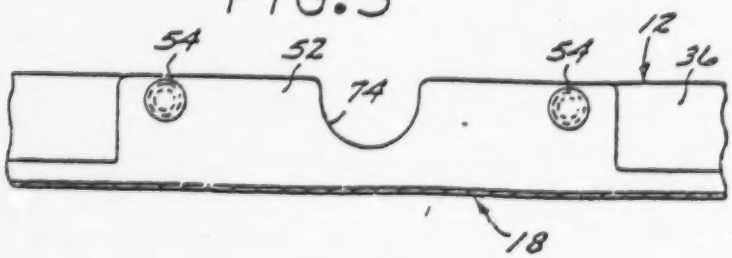
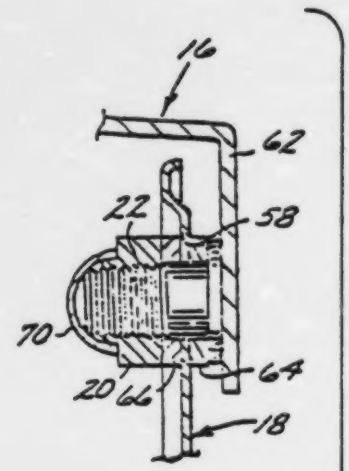
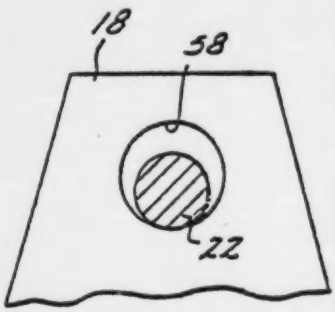


FIG. 4

FIG. 5







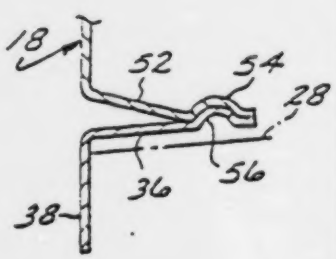
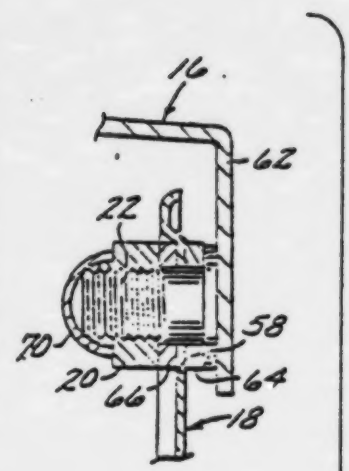
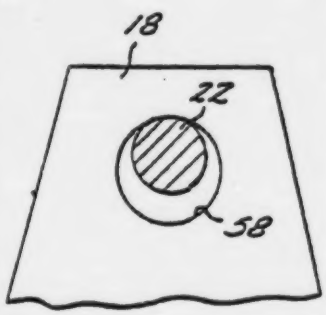


FIG.6





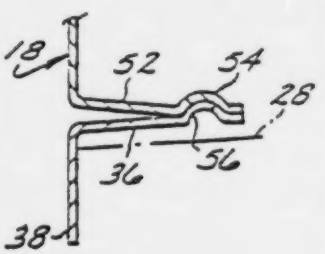
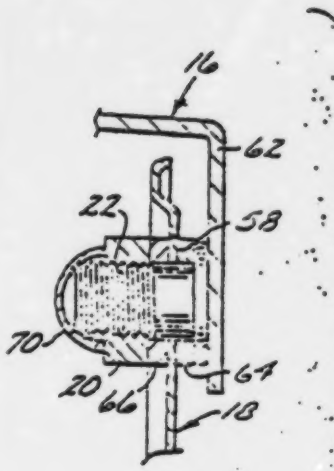
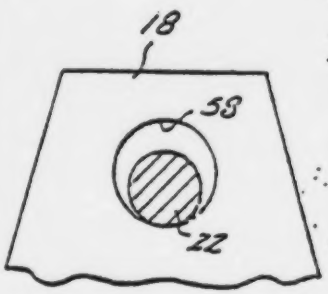


FIG.7





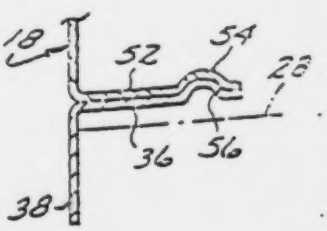


FIG.8

Title: EPA Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

ATTACHMENT A

Page(s) 12 - 15

Not clearly reproducible from submitted document. Copy will be furnished upon request from the U. S. Environmental Protection Agency, Emission Control Technology Division, Test & Evaluation Branch, 2565 Plymouth Rd., Ann Arbor, MI 48105.

ATTACHMENT B

AN AUTOMATIC TIRE AND WHEEL BALANCER

IS HERE

This is an imbalance compensating vehicle wheel attachment invented by Kim Rush of Irvine, California.

By: George S. Schlemmer, P.E.
Member SAE & Veterans of Safety

Any one who has driven a small car very much must know that the two things which affect the stability, handling and the riding comfort of the vehicle the most are the overall weight of the car and the short wheel base. The two characteristics, together, make it imperative that the tire and wheel assembly be perfectly balanced, or as nearly so as possible, and that the balance is also important on a car of greater weight and with a longer wheel base.

In the July 1981 issue of the Automotive Engineering magazine, Mr. Daniel J. Holt, Associate Engineering Editor, stressed the importance of tire and wheel balancing, especially on small cars. He also discussed the difficulty of always attaining such a balance, even with the electronic equipment and computers that are now available for showing the compensating weight required, since human error can always be experienced when the balancing weights are installed.

At last a tire and wheel balancer is available where the possibility of human error in the installation of the tire and the balancing weights is eliminated. In fact, with this balancer, the entire tire and wheel assembly is automatically balanced with every revolution of the wheel in the driving speed range. This is an item that does not require expensive shop installation or maintenance since the only requisite is to be sure that all of the balancing weights that may have been previously used are removed and that the balancer is well seated when it is installed. This is an item that will replace the existing wheel cover or hub cap and it should not be discarded when the automobile is sold or traded, but rather it should be moved from car to car since it is long-lasting; providing, of course, that both cars have the same size wheels.

In operation, the principal application is the force of the radius of gyration which attempts to realign the centers of mass or gravity and the geometric center of the tire and wheel assembly, after the two centers have been deliberately caused to be out of alignment by the tire striking a bump, a rough spot or an obstruction on the surface of the road. Any roughness of about one-eighth inch or more will cause the two centers to be out of alignment, and since there are few perfectly smooth road surfaces, the reactions to the rough surfaces at driving speeds are occuring in milli or micro-seconds, and every such reaction is a balancing action of the tire and wheel.

Figures 1 and 2 show that this imbalance compensating vehicle wheel attachment has a rim structure for mounting to a vehicle wheel, that it has a pularity of spokes or sectors coupled to the rim structure and which extend radially inward to where they are connected to a hub structure of heavy gauge steel. The inner end of the spokes or sectors are connected to the hub structure by a bolt and two washers with a pre-determined degree of tightness, and that they are so connected that they can slide and move radially in relation to the hub. The hole in the spoke is larger than the bolt which holds it to the hub, and this permits the masses of both the hub and the spokes to move dynamically in a radial slidable movement to establish the radius of gyration which tends to compensate for any tire and wheel imbalance.

The outer ends of the spokes are connected by resilient material to the surrounding trim ring and the entire assembly is attachable to the vehicle wheel by gripper members which extend through the ring as shown in Figure 3. Sharp points on the grippers are directed radially and outward which enhances mounting on the wheel by permitting the trim ring to be pressed axially inward due to the resiliency of the gripper base, and once in place, the outward directional points on the gripper prevent outward axial movement as the points dig into the rim. Holding of the grippers is accentuated by the centrifigal force of the masses as the wheel revolves.

By balancing the tire and wheel assembly on each revolution above about ten to fifteen miles per hour, the bounce of the tire from the surface of the road has been greatly reduced, and a substantial saving of fuel, or an increase in the number of miles travelled per gallen of fuel used is realized. This fuel saving has been verified by comparative test driving over a pre-determined course with many different vehicles of various sizes, weights, wheel bases, power plants, etc., and by many vehicles fitted with proto-type balancers being driven hundreds of thousands of miles.

With no bounce, and with perfect contact between the tire and the surface of the road, the relative speed between the bottom dead center of the tire and the surface of the road is zero; however, as the driving wheels of the vehicle bounce and the contact is broken with the surface of the road, and the weight of the vehicle or load is removed, the driving torque will cause the wheel to rotate at a greater speed and the relative speed between the tire and the road will be changed. Any such loss of contact or change in the angular velocity of the tire wastes energy and fuel. By greatly reducing the bounce and by applying an inward pressue to the surface of the road and by providing a greater "footprint" of the tire, both energy and fuel have been saved.

Although the exact theory of operation of these wheel covers is not known, it is believed that in addition to reducing the bounce, that rolling friction is also partially overcome by the action of the balancers. It is believed that when a tire rotates at high speed,

that due to forces including centrifugal force, rotational inertia and gravitational forces, that where the tire strikes the surface of the road, or at the "kiss point", that there is a bulge extending to the fore of the tire in addition to the flattening of the side walls when the load is applied to that portion of the tire.

It is believed that since the same forces, centrifugal, rotational inertia, and gravity, apply to the balancer; but more so because the parts are permitted to move radially in relation to each other, that the reaction of the balancer is at the "kiss point" where the tire meets the road and that the reaction to the bulge in front of the tire is the same as the reaction of the balancer when the tire hits a bump, and that the compensating action helps the tire roll over the bulge and reduce rolling friction to the same extent. It is also believed that less heat is lost since much heat is generated by tire hysterics and since by decreasing the bounce, some flexing of the side walls has also been eliminated and thus less heat is generated.

One of the main benefits derived from the balancers is the affects to vehicle safety. By maintaining better contact with the surface of the road, the stability of the vehicle has been enhanced. It has been documented by N.B.C. that at fifty-five miles per hour, a vehicle can be stopped in up to fifteen feet less distance when it is equipped with the balancers, and it also follows that the better the road contact the less possibility there is of planing or of vehicle spin out.

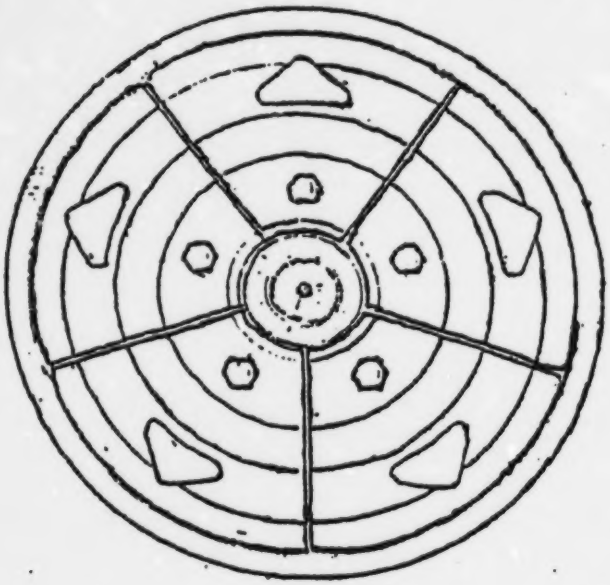


FIG.1

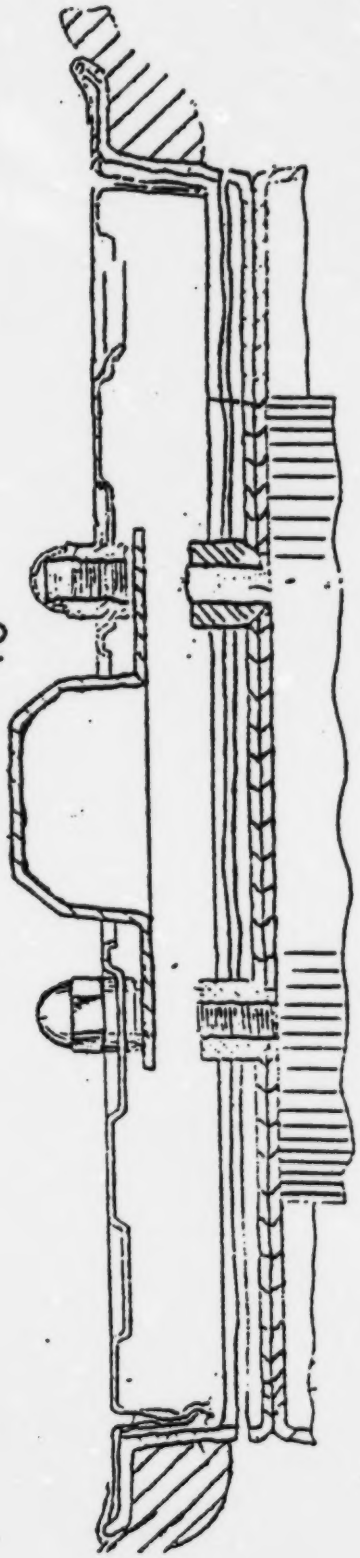
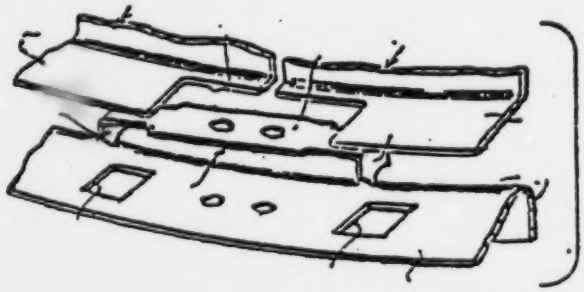


FIG.2

FIG.3



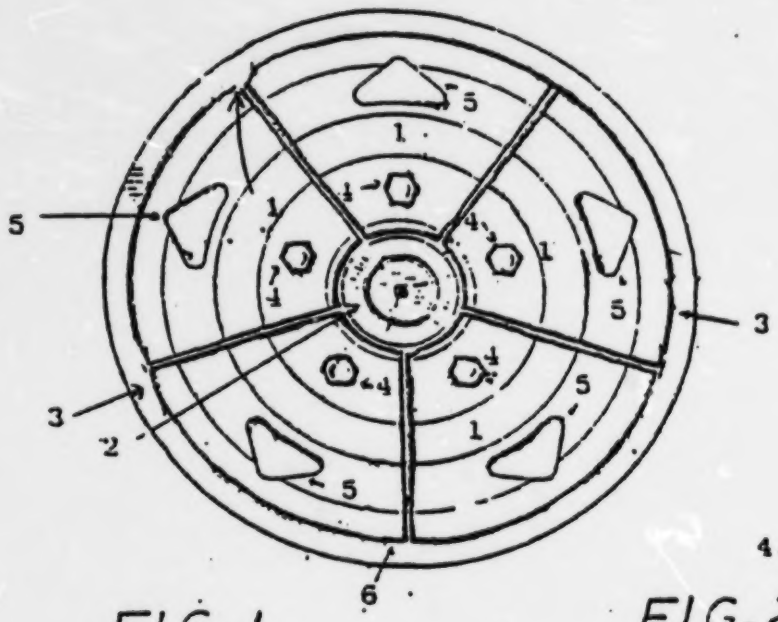


FIG.1

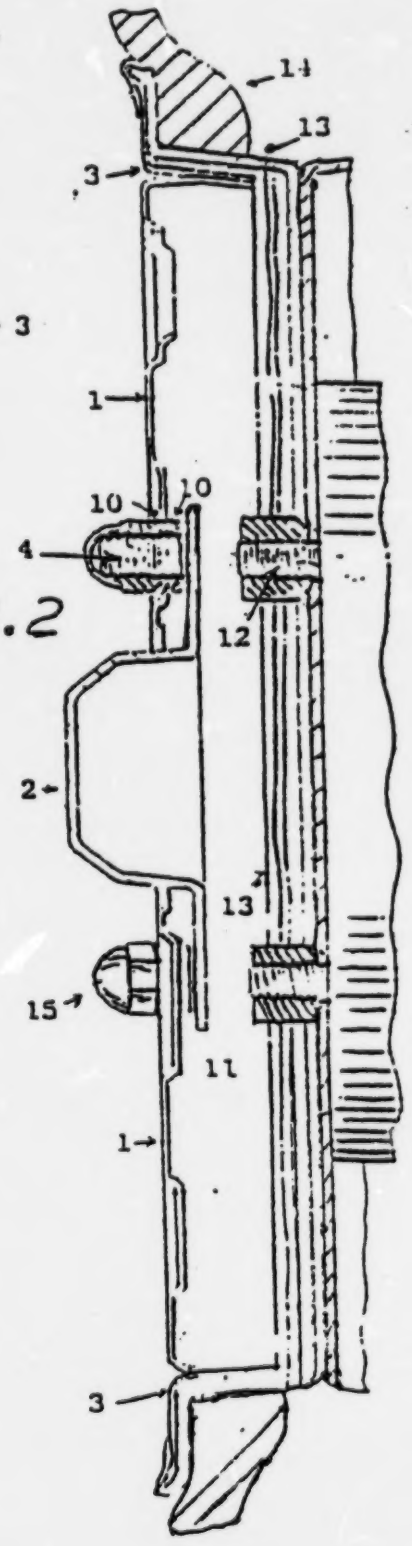
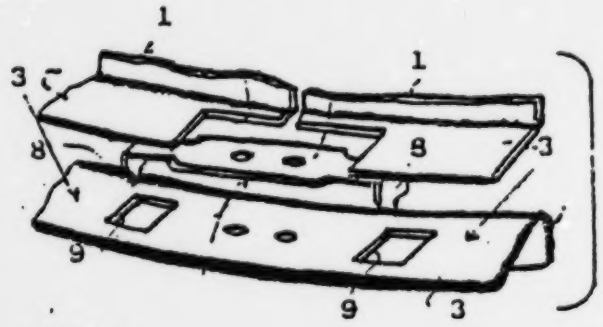


FIG.2

FIG.3



1) Spokes in section
2) Heavy gauge steel hub
3) Trim ring
4) Connecting bolt
5) Vent holes for brake cooling & tire valve
6) Gripper assembly
7) Resilient gripper base
8) Gripper points
9) Hole in trim ring
10) Washers
11) Lug nut on wheel
12) Lug bolt on wheel
13) Rim of wheel
14) Tire
15) Cap nut of wheel cover

ATTACHMENT C

HAS ROLLING RESISTANCE BEEN DECREASED AT LAST?

The following is a hypothesis of what happens in an automobile accessory recently invented by Kim Rush which decreases rolling resistance and provides more miles per gallon of fuel.

George S. Schlemmer
Commander, U.S. Navy (Retired)
P.E., Member SAE and Veterans
of Safety

It is of little consequence whether we say that a tire crawls or rolls across the surface of the road, since both must have one thing in common — and that is that the tire must have good contact or traction with the surface of the road.

With perfect contact the relative speed between the rotating tire and the surface of the road is zero at bottom dead center and the vehicle will move the same distance as the periphery of the tire is rotated, however, if we break the perfect contact even so slightly the speed ratio between the two surfaces is no longer zero. This can be demonstrated by watching the effect of a spinning tire or wheel when a sheet of water separates the two surfaces and a planing effect is established. The vehicle does not move the same distance as the tire and some rolling resistance must be attributed to slippage.

Since the pressure build up in a tire is the function of heat mostly generated by tire hysteresis and since the temperature/pressure relationship does reach equilibrium, it is assumed that the energy lost in this process can be controlled only in the selection of materials and in the method of and type of construction. It has been determined that by using a more resilient and more elastic material of a steel band around the periphery of a tire that another obstacle to rolling could be somewhat overcome. This is the rotational inertia and gravitational distortion that occurs at the kiss point and which is created as the vehicle moves along. Side wall distortion from weight being placed on the tire and the kiss point distortion will continue to create hysteresis and heat and it is only by assisting the tire to roll or crawl over this distortion that rolling resistance can be improved in this area.

Many struts and springs have been devised to dissipate the upward acceleration forces when the wheel bounces and to some extent to aid in maintaining contact betwee the tire and the surface of the road, but only recently has a method of both reducing slippage and to assist the tire to roll over the distortion obstruction been developed. This method puts the reaction to the upward thrust when an obstruction to the smooth surface of the road is encountered down in the wheel where it belongs instead of up in the strut or in the springs.

A treatise by Dr. Franklin Potter, head of the Physics Department at the University of California, Irvine, explains this theory and a portion of his paper is as follows:

ABSTRACT. The upward acceleration of a rolling wheel striking a bump can be decreased by a movable plate attached to the wheel.

TEXT. When a rolling wheel encounteres a small bump, the upward accelaration can be decreased by a movable plate held with springs concentric to the wheel axis. In the first approximation the bump is small enough to produce an impulsive blow. The wheel is treated as a solid disc with a rubber perimeter and the plate is attached by five springs to keep the plate concentric with the rotation of the axis. A simple calculation leads to resulting decrease in upward accelaration.

A specific example is a circular plate of mass M held by five springs to the disc so that its equilibrium position corresponds to having the plate concentric with the disc. When the bump impulse displaces the plate from equilibrium by a distance ℓ the springs with the effective modulus K_s acts to restore the plate to the equilibrium position. The resonant frequency ω_p for the plate oscillation must be much greater than the wheel turning frequency so that a resonance condition cannot be established.

When a small bump acts, the impulse in this approximation occurs within a tenth of a radian or less of the rotation angle for the wheel. Both vertical and horizontal accelaration components are present, but this approximation only considers the vertical motion. The summation of vertical forces on the disc of mass M is:

$$(1)\quad -M_g - K_s\ell + F_{bump} = Ma_d$$

and on the plate is

$$(2)\quad -\underline{m}_g + K_s\ell - \underline{m}\omega^2\ell = \underline{m}a_p$$

The term $\underline{m}\omega^2\ell$ is the centrifugal force term produced by inertia and it depends upon the displacement ℓ This term adds an additional downward force on the plate and on the wheel through the springs.

If the plate were simply rigidly affixed to the disc, the summation of the vertical forces acting upon the disc-plate is:

$$(3)\quad -M_g - \underline{m}_g + F'_{bump} = (M + \underline{m})\, a'.$$

There is more, however Dr. Potter concludes by stating that a practical solution to reduce the upward acceleration of the tire on a wheel has been invented by Kim Rush, inventor of the Gyroscopic Wheel Cover (TM).

The Gyroscopic Wheel Covers are made with heavy gauge flexible steel spokes connected to a trim ring on the outer end and connected to a center hub or floating back plate made of 12 gauge steel, on the inner end. In the present covers, five spokes encompass the inner circumference of the trim ring and they are connected to the floating back plate by a bolt, nut and gasket or washer assembly. Grippers on the outer end of each spoke, projecting through the trim ring, hold the assembly to the rim of the wheel.

As an uneven surface or obstacle of 1/8 inch or more is encountered on the surface of the road, the upward acceleration or force causes a reaction of the floating back plate which then moves down about 1/8 inch and causes a mis-alignment between the geometric center and the center of gravity in the wheel cover. This causes a radius of gyration to attempt to realign the two centers, which creates an additional downward force.

It is obvious then, that in order to actuate the floating back plate that the tire must encounter an uneven surface on the road; however travelling at 55 mph or about 80 feet per second, many such obstacles of 1/8 inch or more are encountered in each revolution of the wheel and therefore, reaction is in milli- or micro-seconds. Since the upward force was generated at the kiss point, or within 1/10 radian of the bottom dead center, with this fast reaction, the additional downward force is returned to the same position.

Newton's Law of Motion states that for every force there must be an opposite and equal force. Since we know that the centripetal force or tension in a rotating body is equal and opposit to the centrifugal force, then any additional force originating within the body would be additive to the centrifugal force.

The construction of the wheel covers permit the back plate to move about 1/8 inch which it does in a downward direction when an outside force moves it from its equilibrium position. The assembly and construction of the flexible spokes also permit an outward movement of about 1/8 inch against the grippers. When the two units move, the force of the plate ($F = ma_p$) striking the spoke is additive to the force of the moving spoke ($F = ma_s$) and in addition, the same rotational inertia and gravitational force that developed the distortion bulge on the tire is applied to the movable spoke. This force is also additive to the force of the moving plate and spoke.

Since all action is in milli-micro-seconds, the entire force of movable plate and spoke is applied to the distortion bulge. The reactive force to this total additional downward force (including the force of the radius of gyration) are those of an imperfect elastic body reacting to the impact force. These are the forces of compression and the force tending to restore the body to its shape before the compression.

Thus, the additional forces originating in the wheel cover tend to decrease the upward acceleration of the tire and provide additional tire/road contact to decrease slipping, and by adding extra energy, they assist the tire to roll or crawl over the rotational inertia, gravitation bulge obstruction, and reduce rolling friction.

Why a hypothesis? Because, as Dr. Potter stated, "These wheel covers seem to be smarter that we are." This though, does seem to be the only logical conclusion to how such amazing results have shown up in test runs and at the fuel pump.

Title: EPA Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act (Applicant's Encl (2) Simple Physics Explanation

ATTACHMENT C

Page(s) 24 - 26

Not clearly reproducible from submitted document. Copy will be furnished upon request from the U. S. Environmental Protection Agency, Emission Control Technology Division, Test & Evaluation Branch, 2565 Plymouth Rd., Ann Arbor, MI 48105.

ATTACHMENT D

NATIONAL TESTING STANDARDS INC.
RESEARCH AND TESTING LABORATORIES
877 S. ROSE PLACE
ANAHEIM, CALIFORNIA 92805
(714) 991-5520

REPORT NO. 10751

November 5, 1979

Client: Mr. Ken Rush,
#6 Emperor,
Irvine, Ca. 97214

Subject: Evaluation of Gyroscopic Wheel Covers

Reference: Conferences with Messrs. R.Winkler and K. Rush

Sample Description:

One set (4 each) of patented automotive hub caps was submitted by the Client and identified as the Gyroscopic Wheel Covers.

Leased from Dollar Rent-a-Car in Santa Ana by National Testing Standards Inc. was one stock 1979 Chevrolet Camaro with a 350 in^3 V8 engine, two barrel carburator, automatic transmission and H78-14 tires. Published weight for this car is 3,500 lbs.

Request:

Determine the effect on gasoline mileage of the submitted patented automotive hub caps.

Method:

One hub cap was attached to each wheel of the furnished car and the car fuel tank was filled with gasoline to a reproducible mark.

The car was driven by a representative of National Testing Standards Inc. for twenty-one and five tenths (21.5) miles south east along Interstate 5 departing from Irvine, Ca. The car was driven at a steady 54 miles per hour with mileage and air temperature recorded every ten minutes. At the end of the twenty-one and five tenths miles the car was driven off the freeway, across the over pass and back on the freeway headed back toward Irvine.

(Cont'd)

NATIONAL TESTING STANDARDS INC.

November 5, 1979

At the end of the return trip the car was parked in exactly the same spot. The fuel tank was filled to the original mark with a measured quantity of gasoline. This quantity was measured with a calibrated volumetric graduate.

The hub caps were removed and the exact same route repeated to the exact minute of elapsed time.

The round trip with the hub caps on was performed between 11:07 A.M. and 12;03 P.M. The round trip without the hub caps on was performed between 12:27 P.M. and 1:24 P.M.

Tire pressure was measured before and after each round trip.

Results:

The total mileage for each round trip was 43.4 miles.

With the gyro stabilized hub caps on, the leased car consumed 1.55 gal. per round trip which is an average of 28.0 miles per gallon.

Without the gyro stabilized hub caps on, the leased car consumed 1.95 gal. per round trip which is an average of 23.5 miles per gallon.

During the round trip with the gyro stabilized hub caps on, the air pressure remained at 28 psi in all four tires.

During the round trip without the gyro stabilized hub caps on, the air pressure increased from 28 psi to 30 psi in both left tires.

Conclusion:

The average miles per gallon increased by 19.1% for the round trip which used the gyro stabilized hub caps.

Ref:99107

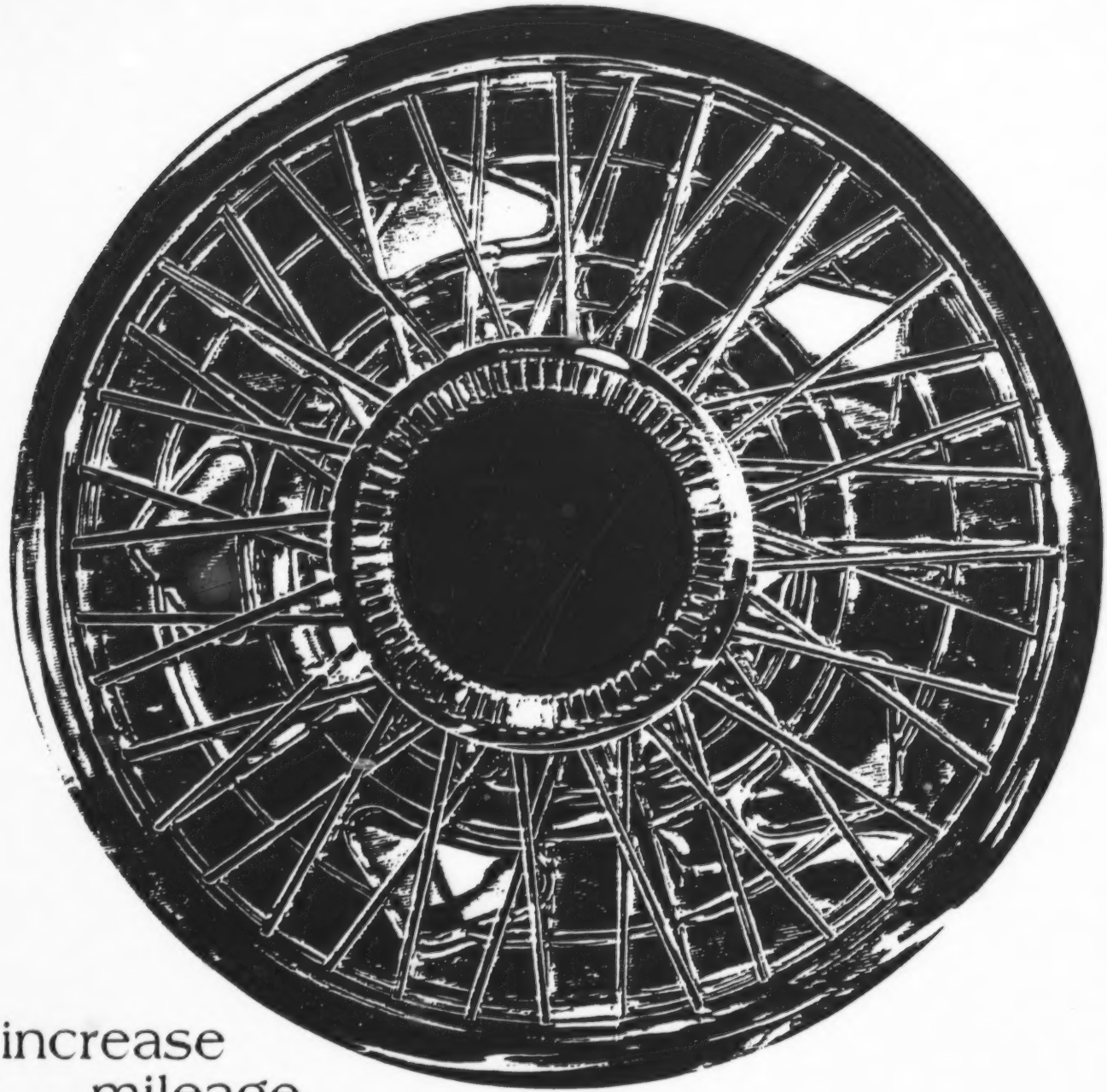
NATIONAL TESTING STANDARDS

by Lewis F. West

energy efficient... money saver...

ATTACHMENT E

greater road safety



increase
mileage
increase tire life
increase brake life
increase traction in snow

filmed tests indicate vehicle braking reduced by fifteen feet at 55 m.p.h.

what makes it work...

The Gyroscopic Wheel Cover™ has a 12-gauge steel movable back plate, movable spokes, and is suspended within the wheel by steel spring grippers. The force created by the tire striking the ground creates a radius of gyration, six pounds of movable heavy gauge steel which gives a perfect geometric center with a perfect center of gravity giving a perfectly balanced wheel. This eliminates tire bounce and greatly enhances stabilization.
The 360° of flexing gyroscopic mass forces the geometric center and center of gravity to become aligned thereby causing an automatic wheel balance that shifts and adjusts to compensate for any imbalance in road conditions or speed change. The Gyroscopic Wheel Covers™ react in milli-microseconds to maintain constant balance. This continuous response creates a perfect wheel balance and constant stabilization that results in the rear wheels exerting a steady push while the front wheels offer less resistance to rolling.

The increased stability from the Gyroscopic Wheel Covers™ means a smoother ride, better road contact, reduced front end wear, less uneven tire wear and an increase in gas mileage.

fuel saver – patented and tested

Patent No. 4,268,090 was issued by the United States Patent Office to Kim Rush, noted inventor on May 19, 1981. The patent was issued on a device that was in development for 15 years and in testing for four years. Testing was done by the University of California at Irvine, State of California, Federal Certified Independent Testing Laboratory, Firestone Tire Company, S.A.E. Engineer, Technology Transfer, N.B.C. News and many others. All tests showed in excess of 16% increase in gasoline mileage.

tests prove

Tests prove – Greatest Safety Invention since the Hydraulic Brake! N.B.C. News tests on film show vehicle braking distance reduced by 15 feet at 55 M.P.H. National Safety Council viewed tests. "unquestionably Gyroscopic Hubcaps™ will provide safer vehicle operation by motorists throughout the world." Tests run by McDonnell Douglas aircraft on wet pavement showed absolutely no indication of hydroplaning or side sliding.

90 day money back guaranty

If product does not perform as described herein, after 90 days of continuous usage your purchase price will be refunded.

exclusive marketer of

Gyroscopic Wheel Covers™

ZIMMER WHEELS INC.

1330 Leyden Street • Denver, Colorado 80220 • (303) 329-0206

Gyroscopic Wheel Covers™ offer you:

Safety

1. Better tracking and control.
2. Vehicle holds road better.
3. Wheel stability adds traction in snow and ice.
4. Smoother ride.
5. Reduced braking distance.
6. High-speed throwoff of cover almost impossible due to wheel cover expanding while in motion.
7. Stability reduces hydroplaning on wet pavement.

Savings

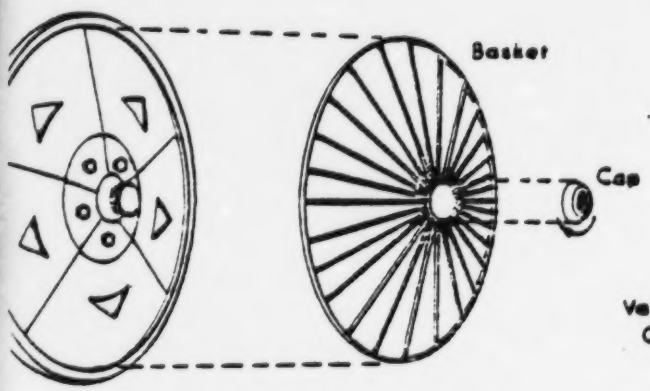
1. Up to 16% or better mileage – 16% equals over $4.00 savings on a 20-gallon tank of gas.
2. Increased tire life.
3. Improved brake life.
4. Stabilized wheels reduce front end maintenance.

Gyroscopic Wheel Covers™ are available from:

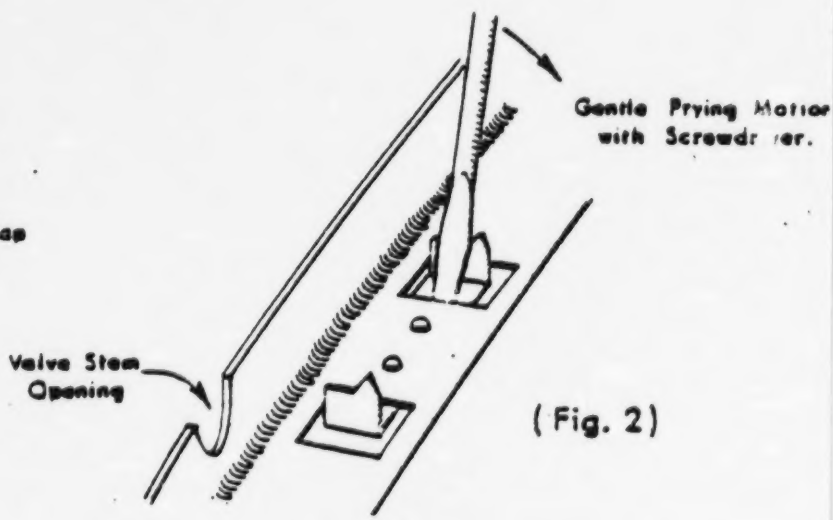
INSTRUCTIONS FOR GYROSCOPIC WHEEL COVER INSTALLATION

ATTACHMENT F

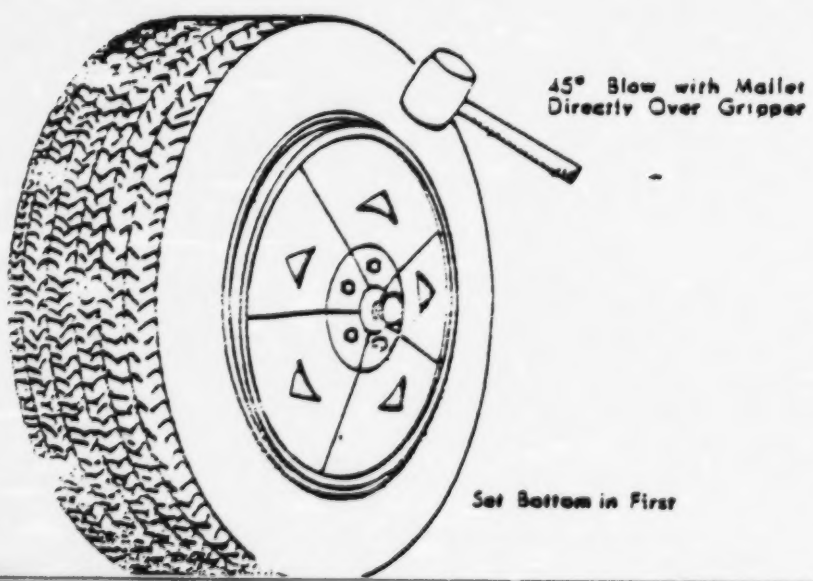
1. Pull factory hub cap off. Remove any lead weights.
   (Fig. 1) Take gyroscopic wheel and unscrew cap to remove basket.
   (Fig. 2) Ease tension in metal grippers with screwdriver between flange and gripper. Install gyroscopic wheel covers by first aligning valve stem with valve stem opening (Fig. 2) (Valve stem extender available at your local auto parts store) (Fig. 3) Set bottom of cover in first (bottom 3 grippers) all the way in. Next with a rubber mallet hit with a downward blow the top 1/3 of trim ring at a 45° angle. Make sure trim ring sits flush with wheel or internal forces cannot operate.
2. Repeat same procedure to remaining wheels.
3. Road test car.



(Fig. 1)



(Fig. 2)



NATIONAL TESTING STANDARDS INC.
RESEARCH AND TESTING LABORATORIES
877 S. ROSE PLACE
ANAHEIM, CALIFORNIA 92805
(714) 991-5520

April 2, 1981

TO WHOM IT MAY CONCERN:

We are an official testing laboratory recognized by the U.S. Federal Government, Army, Navy, State of Calif., etc.

Our name is listed in the "Qualified Laboratory List" No. 24, published by Defense Logistics Agency. Our number in this publication is 13348.

We also have an assigned DCAS number (Defense Contract Administration Service) No. 4-S-502. Our local DCAS office is in Santa Ana, when it becomes necessary to contact our inspector for our Clients' government contract projects.

Respectfully,

Lewis F. West

Lewis F. West,
President,
NATIONAL TESTING STANDARDS

LFW/cs

HOWARD Chevrolet
895 Dove St. at Quail St.
NEWPORT BEACH, CALIFORNIA 92663
Telephone (714) 833 0555

Reproduced from best available copy.

July 16, 1979

G. S. P.

Anaheim, California 92802

RE: TESTING OF GYROSCOPIC WHEEL COVERS

Gentlemen:

Recently I received a set of wheel covers and have been testing them on my 19[illegible] Chevrolet Caprice Classic Sedan; the results are as follows:

Running four (4) complete tank fulls of gas; two (2) in the city and two (2) on the highway, with standard Chevrolet wire wheel covers.

Then, installing the Gyroscopic Wheel Covers and running thru an additional four (4) tanks of gas; two (2) within the city, (to and from work, etc.) and two (2) between Palm Springs and Laguna Beach.

We can testify to the following improvements:

CITY	8.4	to	13.2 high (12.7 low)
HIGHWAY	15.3	to	21.4 high (21.1 low)

The driving was done with regular driving habits and with non-professional drivers. And, cruise control was used on the Palm Springs trips; setting between 55 - 60 average.

I would like to thank you for the opportunity to test such a remarkable product and wish you much success.

Very truly yours,

Kenneth Pierce
General Sales Manager

Title: EPA Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

ATTACHMENT G

Page(s) 35 - 42

Not clearly reproducible from submitted document. Copy will be furnished upon request from the U. S. Environmental Protection Agency, Emission Control Technology Division, Test & Evaluation Branch, 2565 Plymouth Rd., Ann Arbor, MI 48105.

3M Business Products Sales Inc.
A SUBSIDIARY OF 3M COMPANY
107 WEST ARTESIA BOULEVARD • COMPTON, CALIFORNIA 90220
TEL (213) 637-2200

3M BRAND BUSINESS PRODUCTS CENTER

Gyroscopic Wheel Covers
2521 W. La Palma Avenue
Anaheim, California 92801

From J.E. Bolender
3M Co. Suc. Supr.

To Whom it May Concern:

As a satisfied customer of your Wheel Covers I would like to share an experience with you that I feel is quite significant.

The advertisment had indicated that the stability of the ride would be improved by 16.7%. I noticed right away that the ride on my Oldsmobile wagon seemed to smooth out, the cornering ability improved, and it held the road alot better. What surprised me was the way that it held the road when a blowout occured on my left front tire. I was traveling at 50-55 mph and there was no swerve or veering whatsoever. I am convinced that the wheel covers, because of the gyroscopic principle, was significantly responsible for the increased handling ability during the blowout. In addition the wheel covers stayed on the car. In the past they have come off during 3 out of 4 blowouts.

For the possibility of keeping me from having an accident, or even saving my life, I'd like to thank you for putting your product on the market.

Best Regards,
J.E. Bolender

J.E. Bolender

...AUTICS COMPANY
...Newport Beach, CA 92...

McDONNELL DOUGLAS

14 December 1978

Gyroscopic Safety Products
1207 So. Euclid
Anaheim, CA 92802

Attention: K. E. Rush, President

Dear Mr. Rush:

Recently, during the inclement weather we had in November 1978, I was privileged to take a ride in your car with you and your safety consultant, George Schlemmer, which was equipped with the gyroscopic wheel covers manufactured by your company.

Several impressive tests were made at my request in the vehicle during a heavy downpour.

First, to determine stability factors and hydroplaning potential, I requested that a 55-mile speed be maintained on wet pavement and a full braking maneuver executed when traffic permitted. The car came to a straight-on stop and absolutely no indication of hydroplaning or side sliding was noticed. This was impressive in that the pavement was wet with sheets of water and the braking distance and tracking of the vehicle was remarkable.

The second test consisted of attaining a 55-mile speed during the same ride and deliberately veering the right front and rear wheels onto a hard gravel and dirt shoulder, and then recovering with all four wheels back onto hard pavement. Observation of the performance of this vehicle during this road deviation clearly showed that the driver was able to maintain forward tracking and stability with minimum steering wheel effort.

In my opinion, this installation could have a singular impact on driver safety for drivers faced with a similar condition. It was obvious that the improved road contact and the "gyroscopic" function of the wheel covers give an automobile a high stability safety factor and will be an enhancing device for the smart driver.

Very truly yours,

C. R. Harbst

C. R. Harbst, P. E.; CSP; CHCM
16050 Gresham St.
Sepulveda, CA 91343

Title: EPA Evaluation of the Gyroscopic Wheel Cover Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act (Letter from J. Bennett to K. Rush, May 5, 1979

ATTACHMENT G

Page(s) 45 - ____

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ATTACHMENT H

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

February 24, 1983

OFFICE OF
AIR, NOISE AND RADIATION

Mr. David Hudson
Energy Team for Conservation
6759 W. 70th Avenue
Arvada, CO 80003

Dear Mr. Hudson:

We have performed a preliminary review of your January 24, application for an EPA evaluation of the "Gyroscopic Wheel Cover" retrofit device. We have the following concerns:

1. Since section 2.c.(3) of the application states you are authorized to represent Zimmer Wheels, Incorporated, we will need a letter from that company substantiating your authority.

2. Please clarify whether the device can be used on front wheel drive vehicles.

3. Section 3.e. states that testing was "done by an approved Federal testing laboratory, National Testing Standards, Incorporated". While other government agencies may have found it acceptable for their purposes, that company has not been recognized by EPA for fuel economy and exhaust emission testing. We would like to have some additional information on their capabilities and credentials.

4. The installation instructions state to "unscrew cap and remove basket". No further mention is made about reinstalling these components. Please clarify this area. Further, the patent shows that clips (item 40 in Figure 2) are used to ensure the cover does not come off the wheel. No mention is made of these clips in the installation instructions. Please resolve this inconsistency.

5. The test results from National Testing Standards, Incorporated show that without the Gyroscopic Wheel Covers, the Chevrolet Camaro traveled 43.4 miles and consumed 1.95 gallons of fuel and thereby achieved 23.5 MPG. These values indicate it achieved 22.3 MPG. Please clarify this apparent discrepancy.

   Your application indicates that test results have been obtained on more than this one vehicle. Please submit the results of all testing performed on the device.

Overall, the test data you have submitted suggest that there may be fuel economy benefits associated with the device. However, there is a need for more test data obtained from a carefully controlled program at an EPA-recognized independent laboratory. The test program should include on-road testing. Although we have not decided on all the specific details, we suggest you consider the features outlined in Attachment A when designing your program.

I recommend that you contact the independent test labs listed in Attachment B regarding the program suggested above. Should you find one capable of performing the tests, then please contact me so that we can further discuss the details of the program.

Because of our need to process all evaluations in a timely manner, I ask that you respond to this letter by March 11 and that you submit all data by April 11. Should you have questions regarding this matter, please contact me.

Sincerely,

Merrill W. Korth

Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

Enclosure

Attachment A

Test Vehicles

Quantity: Four
Model Range: 1975 thru 1983
Manufacturers: General Motors, Ford, Chrysler, American Motors (see Attachment C)
Number of Engine Cylinders: 8, 6, and 4
Transmission: Automatic

Test Conditions

Test Type: On-Road testing[1]

It is suggested that all on-road testing be performed on the San Antonio Road Route[2] which is described in Attachment D. Should you select some other test location, it will be necessary to run a few pilot tests for purposes of establishing the test-to-test variability and also the required number of test vehicles/tests.

Test Quantity:

1. Twelve valid tests without device per vehicle

2. Twelve valid tests with device per vehicle

Temperature Range: 60 F°to 90°F
Wind: 5 MPH or less, gust to 10 MPH maximum

Miscellaneous Comments

1. All testing should be conducted between 9:00 am and 3:00 pm

2. Two or more practice runs should be made to assure driver repeatability.

3. One warm-up circuit of the test route should be made prior to start of data gathering.

4. Tests without the device should be performed with all tires intentionally out of balance to the maximum extent possible while still maintaining safe driving characteristics.

5. Tests with and without the device should be randomly mixed during each day.

---

1 Because the device is installed on all wheels and also because chassis dynamometer testing includes rotation of only the front or the rear wheels, the device will have to be evaluated using road test procedures.

2 The San Antonio Road Route closely approximates the driving cycle followed during chassis dynamometer testing using the Federal Test Procedure.

Issued: February, 1983
To be revised: July, 1983

Independent Laboratories Recognized by EPA as Capable of Performing Emissions Tests on Motor Vehicles

While the Federal Government does not formally approve laboratories for emission testing of motor vehicles, certain independent laboratories are recognized by EPA as having this capability. Their equipment is identical or equivalent to that used by EPA. The following list of such laboratories also contains the "recognition category" of the laboratory and any additional considerations. These additional items were provided by the laboratory as part of their application. The recognition categories are as follows:

Category Number 1: Laboratories which have successfully completed all requirements for recognition. The recognition category is shown in parentheses following the company name.

Category Number 2: Laboratories which have submitted formal applications but have not yet been inspected. The application indicates that they have the appropriate facilities, equipment and personnel.

Automotive Testing Laboratories, Inc. (1)
P.O. Box 289
East Liberty, OH 43319

Myron Gallogly, President
Telephone: 513-666-4351

Additional Considerations: Diesel, evaporative, catalyst efficiency, mileage accumulation, track, fuel consumption, undiluted emissions, and RTAFRR.

Bendix Test Operations - Bendix Corporation (1)
Test Services Department
900 West Maple Road
P.O. Box 2602
Troy, MI 48299

Ward Diehl, Supervisor
Test Services
Telephone: 313-362-1800

Additional Considerations: Catalyst efficiency, evaporative, fuel consumption, mileage accumulation, track, engine dynamometer, controlled environment, undiluted emissions, humidity control and alcohol.

Custom Engineering (1)
Performance and Emissions Laboratories
7091 A Belgrave Avenue
Garden Grove, CA 92641

Robert Begue
Laboratory Manager
Telephone: 714-891-5704

Additional Considerations: Evaporative, undiluted emissions, mileage accumulation and engine dynamometer.

EG&G Automotive Research, Inc. (1)
5404 Bandera Road
San Antonio, TX 78238

Maurice Forshee
Engineering Assistant
Chassis Dynamometer Test Lab
Telephone: 512-684-2310

Additional Considerations: Fuel consumption, mileage accumulation, track, motorcycle, undiluted emissions, catalyst efficiency, FEEO and humidity control.

Environmental Testing Corporation (1)
1859 Jasper Street
Aurora, CO 80011

A. L. Papay, President
Telephone: 303-344-5470

Additional Considerations: High altitude, diesel, evaporative, particulate and undiluted emissions.

Ethyl Corporation (1)
1600 West Eight Mile Road
Ferndale, MI 48220

William J. Brown
Supervisor, Vehicle Operations
Telephone: 313-399-9600

Additional Considerations: Diesel, undiluted emissions, alcohol, fuel consumption, FEEO and mileage accumulation.

FCI (2)
International Testing Laboratories
3132 West Adams
Santa Ana, CA 92704

Jerry C. Coker
President
Telephone: 714-754-6424

Additional Considerations: Diesel, evaporative, fuel consumption, mileage accumulation and track.

New York City (1)
Department of Environmental Protection
Mobile Source Control Division
75 Frost Street
Brooklyn, NY 11211

John Pinto
Assistant Director
Telephone 212-388-4994

Additional Considerations: Diesel, evaporative and particulate.

Olson Engineering, Inc. (1)
Automotive Research Center
15442 Chemical Lane
Huntington Beach, CA 92649

James Buxton
Manager of Testing
Telephone: 714-891-4821

Additional Considerations: Diesel, evaporative, fuel consumption, particulate emissions, undiluted emissions, mileage accumulation, track and engine dynamometer with diesel and gasoline emissions and marine fuel economy.

SATRA Automotive Emissions Laboratory, Inc. (1)

Route U.S. 1 and 9 South
Newark, NJ 07114

Alexander Kulesha
Laboratory Manager
Telephone: 201-242-7665

Additional Considerations: Evaporative, mileage accumulation and undiluted emissions.

Scott Environmental Technology, Inc. (1)

Route 611
Plumsteadville, PA 18949

Duane Gulick
Manager, Auto Testing
Telephone: 215-766-8861

Additional Considerations: Evaporative, diesel, controlled environment and mobile laboratory.

Southwest Research Institute (2)

Department of Emissions Research
P.O. Box 28510
San Antonio, TX 78284

E. Robert Fanick
Research Scientist
Telephone: 512-684-5111

Additional Considerations: Alcohol, Aldehydes, Catalyst Efficiency, Diesel, Engine Dynamometer, Evaporative, Fuel Consumption, Mileage Accumulation, Particulate, Undiluted Emissions, and Unregulated Emissions.

Texas Transportation Institute (2)

Mailing Address:
Texas A&M University System
College Station, TX 77843

Richard D. Tonda, Manager
Automotive Research Program
Telephone: 713-845-6176

Laboratory Address:
Vehicle Emissions and Fuel Economy Laboratory
Research & Extension Center, Bldg. 7490
Highway 21 West
Bryan, TX 77801

Additional Considerations: Undiluted emissions, fuel consumption, mileage accumulation, track, and engine dynamometer.

University of Santa Clara (2)
Mechanical Engineering Department
Mechanical Engineering Lab., Room 511
Santa Clara, CA 95053

Ms. Kelly Erin O'Brien
Laboratory Manager
Telephone: 408-984-4325

Additional Considerations: Alcohol, aldehydes, catalyst efficiency, diesel, engine dynamometer, evaporative, fuel consumption, gas chromatography, mileage accumulation, undiluted emissions and smog chamber analysis.

The basic condition for EPA recognition is the capability to perform exhaust emissions testing on light duty vehicles according to the current Federal Test Procedure. Each laboratory has additional capabilities. Key words listed with each entry are explained below:

Alcohol - Methanol and/or Ethanol fuel testing capability.

Aldehydes - Aldehyde measurement capability using the MBTH method.

Catalyst Efficiency - Capability to measure emissions levels both before and after a catalytic converter.

Controlled Environment - Capability to conduct emission tests at ambient conditions outside the range of the Federal Test Procedure.

Diesel - Capability to measure gaseous emissions from light duty vehicles equipped with diesel engines.

Engine Dynamometer - Capability to test engines which are not installed in vehicles.

Evaporative - Capability to measure evaporative emissions using the enclosure technique ("SHED") specified for late model light duty vehicles.

Fuel Consumption - Capability to measure fuel consumption using volumetric and/or gravimetric techniques.

FEEO - Fuel Efficient Engine Oil testing.

High Altitude - The laboratory is located at an elevation considered "high altitude" by EPA regulations. Potential applicants for Section 511 Evaluations should be aware that test results at high altitude on certain types of devices (e.g. air bleeds) will not be accepted by EPA. Please check with Merrill Korth, EPA's Device Evaluation Coordinator, before arranging for such testing. His telephone number is (313) 668-4299.

Humidity Control - Humidity in test cell can be adjusted and maintained.

Mileage Accumulation - Capability to accumulate mileage over established road routes.

Motorcycles - Capability to measure exhaust emissions from motorcycles according to current Federal Test Procedures.

Particulate - Capability to measure particulate emissions.

RTAFRR - Real Time Air Fuel Ratio Recording.

Track - Access to facility for use in controlled mileage accumulation, coast down determinations, performance testing and driveability evaluations.

Undiluted Emissions - Capability to measure raw exhaust emissions.

Unregulated Emissions - Capability to measure H_2S, NH_3, SO_2, SO_4, N_2O, total cyanide, organic amines, organic sulfides, phenols, methanol, ethanol, nickel carbonyl, individual hydrocarbons, soluble organic fraction, BaP, PNA, nitropyrenes, Ames bioassay, metals, CH&N, visible smoke, etc.

Mobile Laboratory - Capability to establish a portable laboratory in remote locations.

For additional information, please contact John White or Matthew Macocha at EPA's Motor Vehicle Emission Laboratory, 2565 Plymouth Road, Ann Arbor, MI 48105. The telephone number is (313) 668-4315.

Table 1
Suggested Test Vehicle and Engines for 511 Applicants

The following are suggested as suitable candidate vehicles to be used to generate support data for a 511 evaluation by EPA. By choosing one or more of these, the applicant is assured that the process/device is applicable to a representative portion of the fleet for the model year of interest. The ease of obtaining a test vehicle is enhanced because of the popularity of these models. Newer vehicles chosen for testing should have odometer readings of 10,000 to 20,000 miles. The following list is broken down by year and manufacturer. The ranking for any given manufacturer is by sales volume.

Model Year	Manufacturer	Suggested Gasoline Engine Test Vehicles	Engines (CID)
1981	GM	Citation*/Skylark/Phoenix/Omega	151 L-4/173 V-6*
		Chevette/T-1000	98 L-4
		Malibu*/Cutlass/Century/Regal	229/231 V-6
			260/265/267* V-8
	Ford	Escort*/Lynx	98 L-4*
		Mustang/Capri	140 L-4/200 L-6
		Fairmont*/Zephyr	200 L-6*/255 V-8
	Chrysler	Omni/Horizon	105/135 L-4
		Aries*/Reliant	135*/156 L-4
	AMC	Concord/Spirit	258 L-6
	Volkswagen	Rabbit	105 L-4
	Toyota	Corolla/Celica/Tercel	108/144/89 L-4
	Datsun	210/310/200 SX	91/119 L-4
	Honda	Accord/Civic	107/91 L-4

*Note: These vehicles and engines are currently part of EPA's test vehicle fleet used to evaluate 511 processes or devices.

1980	GM	Citation/Skylark/Phoenix/Omega	151 L-4/173 V-6
		Chevette	98 L-4
		Malibu/Cutlass/Century/Regal	229/231 V-6
			260/265/267 V-8
	Ford	Mustang/Capri	140 L-4/200 L-6
		Fairmont/Zephyr	200 L-6/255 V-8
		Thunderbird/Cougar	255/302 V-8

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Chrysler	Omni/Horizon	105 L-4
	Aspen/Volare	225 L-6/318 V-8
AMC	Concord/Spirit	258 L-6
Volkswagen	Rabbit	89/97 L-4
Toyota	Corolla/Celica/Tercel	108/134/89 L-4
Datsun	210/310/200 SX	85/91/119 L-4
Honda	Accord/Civic	107/91 L-4

Suggested Powerplants for the 1973 - 1979 Model Year Test Vehicles

1979 Model Year	1978 Model Year	1977 Model Year	1976 Model Year
General Motors	General Motors	General Motors	General Motors
305 CID V8	350 CID V8	350 CID V8	350 CID V8
301 CID V8	305 CID V8	305 CID V8	305 CID V8
231 CID V6	231 CID V6		
98 CID L-4			
Chrysler Corp.	Chrysler Corp.	Chrysler Corp.	Chrysler Corp.
318 CID V8	318 CID V8	318 CID V8	318 CID L6
225 CID L6	225 CID L6	225 CID L6	225 CID V8
Ford Motor Co.	Ford Motor Co.	Ford Motor Co.	Ford Motor Co.
302 CID V8	351 CID V8	400 CID V8	351 CID V8
200 CID L6	302 CID V8	351 CID V8	250 CID L4
140 CID L4	200 CID L6	302 CID V8	140 CID L6
American Motors	American Motors	American Motors	American Motors
258 CID L6	258 CID L6	258 CID L6	258 CID L6

1975 Model Year	1974 Model Year	1973 Model Year
General Motors	General Motors	General Motors
350 CID V8	350 CID V8	350 CID V8
400 CID V8		
Chrysler Corp.	Chrysler Corp.	Chrysler Corp.
318 CID V8	318 CID V8	318 CID V8
225 CID L6	225 CID L6	225 CID L6

Ford Motor Co.	Ford Motor Co.	Ford Motor Co.
351 CID V8	400 CID V8	400 CID V8
302 CID V8	351 CID V8	351 CID V8
250 CID L6	140 CID L4	122 CID L4
American Motors	**American Motors**	**American Motors**
258 CID L6	258 CID L6	258 CID L6
232 CID L6	232 CID L6	232 CID L6

Suggested Diesel Vehicles

1978 through 1981 GM 350 CID diesel powered passenger cars.
1977 through 1981 Volkswagen Rabbit diesel or Dasher diesel.

Attachment D

SAN ANTONIO ROAD ROUTE TEST PROCEDURE

A. The general procedure is as follows:

1. Drive test vehicle from Southwest Research Institute to Layover Point.

2. Start vehicle.

3. Start Fluidyne Recorder, wait 60 seconds. Then drive road course. Use normal driving techniques.

4. Return to Layover Point, shift into park, idle for 60 seconds. At 60 secs, stop Fluidyne totalizer and hit print button. Record fuel and temperature readings on work sheet.

5. Shut engine off, zero and start Fluidyne timer.

6. At 500 seconds, start vehicle using hot start procedure.

7. At 560 seconds shift into drive and drive road course using normal driving technique. (Go to Step 4 - repeat as many times as possible before 3:00 p.m.).

B. General Test Requirements

1. The first test run of each day is considered warm-up and the data is not used in any subsequent calculations.

2. Only tests run between 9:00 a.m. and 3:00 p.m. are used due to San Antonio traffic considerations.

3. Only tests on run on weekdays, Monday through Friday, are used due to San Antonio traffic considerations.

4. Temperature, humidity, barometer, wind speed and direction are to be taken at 9:00 a.m. nd 3:00 p.m.

5. All test vehicle fuel tanks are to be drained prior to start of testing to avoid fuel mixing.

6. Commercially available pump fuel meeting the following requirements must be used for all testing.

   a. The fuel must be from a major supplier (e.g., Mobil, Shell, Texaco).

   b. It must meet the octane and lead requirements recommended by the manufacturer of the test vehicle.

   c. The fuel must be of a blend appropriate to season for the test location selected.

d. For each car, fuel from the same batch must be used throughout the program.

7. All vehicles are to be examined for proper vacuum line routing and evidence of tampering and the engine set to manufacturer's specifications.

8. Vehicle tire pressures are to be checked and set to manufacturer's specifications each morning prior to leaving Southwest Research.

9. Test runs with abnormal time, fuel consumption, or circumstances are to be deleted from consideration.

10. Testing run on wet pavement will not be used in the analysis. When pavement is damp the reslts are to be used if they appear in-line with other measurements.

11. A minimum of 5 tests are to be run with most vehicles to familiarize the driver with the vehicle and route. Data is not collected during driver familiarization.

12. The fuel totalizer display should be located in the vehicle so that the driver can not see the display while driving.

San Antonio Road Route

Number of Stop Signs: 0
Number of Stop Lights: 28
Average Distance: 7.2 miles
Average Speed: 19.6 mph
Maximum Speed: 55 mph
Stops/Mile: 3.9

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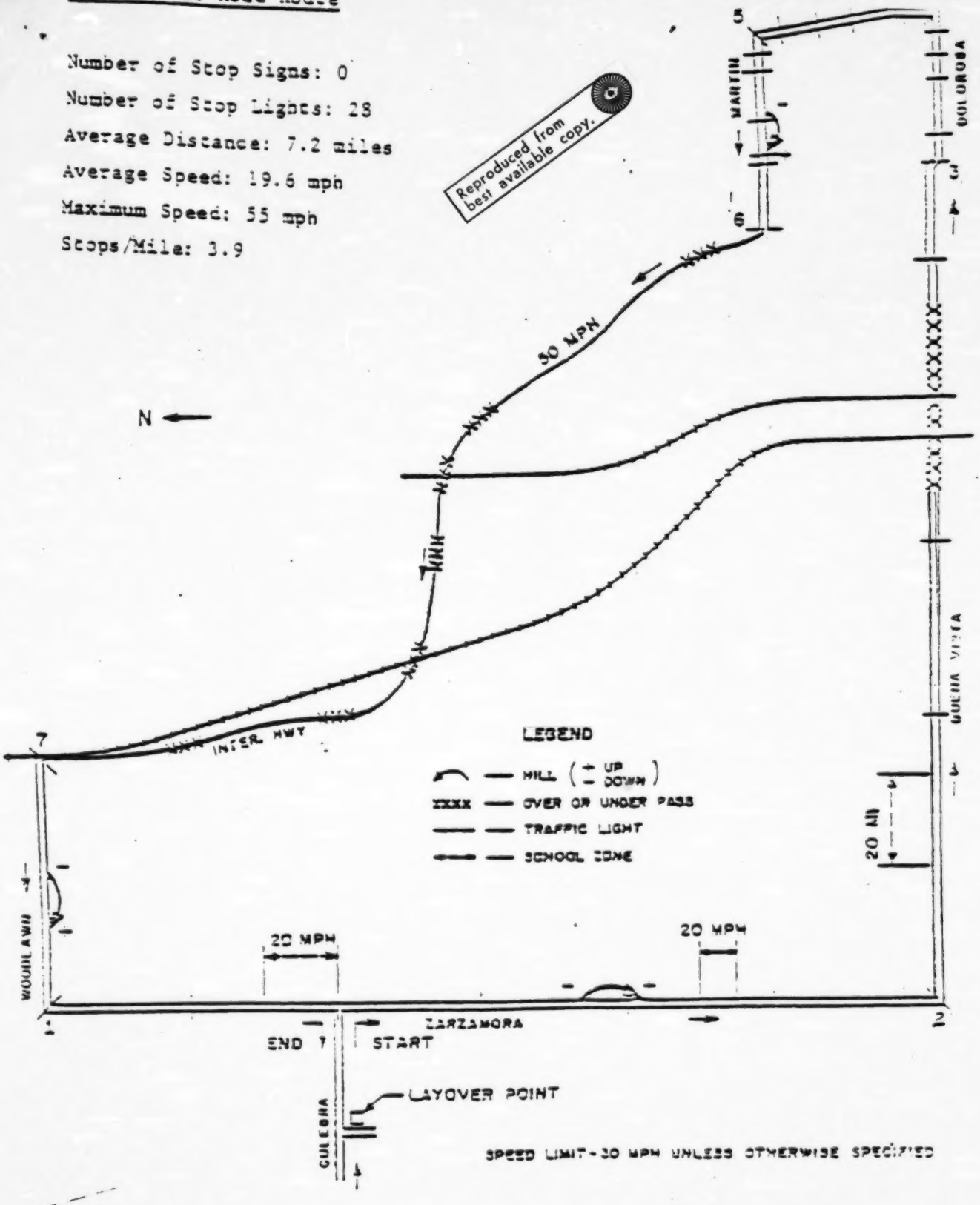

Figure D-1 San Antonio Road Route